11. We need to study much further the anti-toxic and bactericidal properties of human blood serum, and the means by which we can avail ourselves of the same.

12. Some such classification as I have attempted to give of the various causes of lowered resistance to infection, or of the causes of *vulnerability* or susceptibility, will certainly assist in a due appreciation thereof, and will often aid in so fortifying the patient that he may resist infection to which he would otherwise succumb.

13. The condition of entero-sepsis, fecal toxæmia, stercoral intoxication, or whatever it may be called, is certainly one which every practitioner has to fear and against which he should assiduously guard. It is not sufficiently generally recognized and combated.

14. A sub-form of this condition might justly be made and be entitled gastro-sepsis, comprising cases where defective stomach digestion, often from dilatation, brings about a lithæmic or other toxæmic condition which favors infection.

15. Antiseptic agents in the past have worked a revolution in surgical practice and results. We have now reached a time when we know that they all have their disadvantages, and also understand how, if we are strictly aseptic in our work, we can afford to discontinue their application to wound surfaces.

16. But the insurance of the aseptic character of such work necessitates the use of antiseptic agents of some kind upon everything which may directly or indirectly come in contact with these surfaces.

17. When this work is strictly aseptically performed, the use of drains or further employment of antiseptics is either an expression of mental uncertainty or of fear. It may be in the interest of humanity, undoubtedly it often is, but it is not attaining the ideal of scientific work.

TWO CASES OF PREGNANCY WITH BRIGHT'S DISEASE AND ALMOST COMPLETE SUPPRESSION OF URINE.

By G. Ernest Herman, M.B. Lond., F.R.C.P.,
OBSTETRIC PHYSICIAN TO THE LONDON HOSPITAL, AND LECTURER ON MIDWIFERY; EXAMINER IN MIDWIFERY TO THE ROYAL COLLEGE OF SURGEONS OF ENGLAND; TREASURER TO THE OBSTETRICAL SOCIETY OF LONDON, ETC.

An obstetric physician cannot help being interested in the pathology of puerperal eclampsia. The theory of this disease which has the most reason in its favor is that the convulsions of puerperal eclampsia are caused in the same way as uræmia apart from pregnancy.

But the pathology of ordinary uræmic convulsions appears to me to scarcely yet rest on a firm basis. It seems generally accepted that uræmic convulsions are a result of imperfect elimination of certain waste products that ought to have been got rid of by the kidneys. Various views have been put forth as to what these products are, where they are retained, what changes they undergo, and in what form they produce the symptoms of uræmia. But there seems to be agreement as to the fact that in health they appear in the urine, for the most part in the shape of urea.

I have not been able to find in any text-book which treats of kidney diseases any proof, or attempt at proof, or reference to proof, that uræmic convulsions are associated with deficiency either of urine or urea. But in conversation with physicians whose line of practice makes them specially familiar with renal disease, I find that the proposition that in uræmia the elimination of urea is diminished is to them a truism so repeatedly verified by experience that no one thinks that the publication of detailed evidence for its demonstration is needful. Doubtless, then, this view is correct. But I have quite failed to get, either from reading or from verbal inquiry, any information as to what *degree* of defect in the elimination of urea is sufficient to produce uræmia, or how long a great diminution must last before convulsions or other uræmic symptoms are produced. One would, of course, not expect that a very rigid limit could be laid down which should hold good for all cases, but surely some law must be capable of definition.

I have published in the *Transactions of the Obstetrical Society of London* (vols. xxix., xxxii., and xxxiii.) a series of twelve cases of puerperal eclampsia in which the urine was measured and the quantity of urea in it estimated. In every case it was found that while the fits were occurring there was diminution in the excretion of urea. These observations harmonize with what would have been expected if puerperal convulsions are uræmic, and the current conception of the pathology of uræmia is correct.

But there are observations which tend to show that the pathology of uræmia is not quite so simple as this. Carter[1] speaks of "the absence of convulsions so often characterizing the uræmia of absolute suppression in persons healthy up to the time of the suppression, of which probably most physicians have seen examples." Sir W. Roberts[2] says: "Sometimes, however, very great scantiness of urine, or even total suppression (in acute Bright's disease) may exist without evoking any uræmic symptom. In a case of scarlatinal dropsy related by Biermer complete suppression of urine continued for five days without uræmia; then followed a further period of four and a half days in which urine was secreted, but only in the scantiest proportions (a few teaspoonfuls a day), and yet no uræmia.

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[1] Bradshaw Lecture "On Uræmia," Brit. Med. Journal, 1888, vol. ii. p. 466.

[2] Urinary and Renal Diseases, 2d edition, p. 421.

At the end of this second period the urine began to flow abundantly for a short time, and then again became scanty. Three days later uræmic coma set in, followed by convulsions, which proved fatal."

In the present communication I report a case in which there was almost absolute suppression of urine, lasting a week, and very great diminution in the amount of urine for two weeks; and the excretion of urea was diminished even more than in proportion to the quantity of urine, and yet there were no convulsions.

I report, also, another case in which the diminution in the quantity of urine was not so great as in the first case, and the amount of urea in it was only once estimated; but the flow of urine for more than a fortnight was far below the average of health, and below the quantity passed in some cases of eclampsia.

I refrain from any attempt at generalization, further than to say that Case I. and the case Sir W. Roberts quotes from Biermer seem to me to show that mere diminution of the excretion of urea in the urine cannot be *per se* the cause of uræmic convulsions.

CASE I. *First pregnancy: symptoms of renal disease coming on during the last three months; intra-uterine death of fœtus and premature delivery; almost complete suppression of urine for eight days after delivery; great diminution for two weeks; diminution of urinary solids and urea; albuminuria; vomiting; diarrhœa; œdema; delirium; pericarditis in third week after delivery; parotitis in fourth week; retinal hemorrhages; death eleven months afterward.* (From notes by Dr. Hugh Smith, resident accoucheur, and Mr. A. H. Smith, clinical clerk.)—M. A. McC., aged twenty-five. Admitted to the London Hospital October 29, 1889, under the care of Dr. Herman. Patient was a domestic servant, and remained in her situation until three months before admission. No previous illness, except smallpox when aged about twenty. First menstruated at fourteen. After the first appearance of the catamenia they ceased for six months, then returned, and from that time till her pregnancy she was regular every month, flow lasting two days, and being scanty and painless. Patient was not married, and the pregnancy was her first.

During the first three or four months of pregnancy patient suffered severely from vomiting every morning. At the beginning of the fourth month of pregnancy her legs began to swell. This swelling was as great in the morning as in the evening. About the sixth month she began to suffer from an enlargement of a vein in the right leg, and for this reason, and not because she felt ill in any other respect, she left off work. During the last three months her face was puffy. Three weeks before admission she noticed that her urine was scanty and dark-colored, and at the same time she had a slight aching pain across the loins. These symptoms lasted about six days. From that time until her confinement she had to get up three or four times in the night to pass water. The water was pale in color and she thought more than the usual quantity.

She was delivered of a stillborn child on October 28th. She thought herself about a fortnight short of full term. The labor was easy, only lasting seven hours. Immediately after delivery patient became very restless, could not sleep, and was very thirsty. She passed no urine for fifteen hours after her confinement, when six drachms were drawn off.

Next morning (*October 29th*) she was said to have been feverish, thirsty, and somewhat delirious, and her sight became suddenly indistinct, so that she could only see the outlines of things, but not details. She was brought to the hospital and admitted.

On admission she complained of great pain across the loins and was very thirsty. She was pale and anæmic. Eyelids so œdematous that they could not be separated more than one-quarter of an inch; legs œdematous. Optic discs slightly swollen and outline indistinct, but no retinal hemorrhage in either eye. Sight bad; could count fingers at two feet distance with the right eye; at three feet with the left; could not distinguish faces. Heart's impulse strong and widely diffused. Loud and harsh systolic murmur heard over the whole cardiac area, but especially over the base on the left side. Pulse full, but compressible; 104 per minute. Has not at any time had headache; none now.

30*th*. At 6 P.M. on the 29th was dry-cupped over loins, and at 7 P.M. had a hot bath, which produced profuse perspiration. At 8 P.M. vomited, and some hemorrhage from the uterus took place. During the night was restless and did not sleep; slight apparent delirium at times.

31*st*. Patient had a hot-air bath last evening, and sweated freely while in it and for half an hour or more afterward. Loins were again dry-cupped, and this gave great relief, removing a persistent dull pain that had troubled her all day. Eyelids less œdematous than on admission. Is less thirsty. Last night was restless and a little delirious, wanting to get out of bed. No convulsions, nor anything like the premonitory symptoms of one. Is taking milk with lime-water, soda-water, and "Imperial," and tr. ferri perch. ♏x ter. die. There is occasional vomiting, which does not appear to be provoked by food or medicine. Bowels open five times in last twenty-four hours; motions loose.

November 1. Hot-air bath last night, which produced free perspiration. A retinal hemorrhage discovered this morning. Bowels open once.

2*d*. Bowels yesterday open thirteen times; motions loose. Troublesome vomiting of green, bilious stuff. Pulse less full. Murmur not so loud. Milk stopped; patient taking brandy and soda and iced water.

3*d*. Diarrhœa continues. Vomiting less frequent. No pain. Œdema less. Taking now about eighteen ounces of milk in the twenty-four hours with soda-water or lime-water. Ophthalmoscopic examination by Mr. Warren Tay: discs ill-defined, œdematous; numerous small hemorrhages in both eyes.

5*th*. Vomited yesterday. Pain in umbilical region complained of. Appetite bad. No headache. Restless. Œdema less.

6*th*. Some diarrhœa. Still very restless. Chloral last night, which gave some three hours' sleep.

7*th*. Hot-air bath last night; sweated freely. Also dry-cupped.

8*th*. Hot-air bath and dry-cupping repeated last night.

9*th*. Signs of neuro-retinitis more marked. Diarrhœa continues. No vomiting. No headache. Sleeps better. Œdema gone.

12*th*. A few moist râles at lung bases. Has been dry-cupped every other day, and had hot-air bath, in which she sweats freely. Still restless at night.

14*th*. Appetite improving; patient less anæmic. Still on milk diet.

15th. Vomited once. Complains of a sensation of something swelling in her head. Slight epistaxis.

16th. About 4.30 A.M. complained of oppression of breathing, which was relieved by sitting up, and a little brandy. At 10.30 A.M. respirations 38 per minute; complained of weight on the chest. Pericardial friction sound heard over a small area to left of sternum. Fine crepitations at lung bases, but no dulness. Patient looks ill; hands and nose cold.

17th. Breathing very distressed. Respirations 40. Pulse 120, small and compressible. Pericardial sound well marked.

20th. Breathing now easy. Pulse 104. Now no abnormal cardiac sounds. Patient seems better in every way.

21st. Left parotid gland swollen and tender; left side of face so swollen that left eye is completely closed. Temperature 100° last night, normal this morning. Pulse 114.

26th. Parotid swelling has disappeared. No pain. Last two days some hemorrhage from rectum, blood being intimately mixed with fecal matter. Pulse 120, very weak. Patient anæmic.

28th. Per rectum, some thickening and great tenderness on each side of uterus.

29th. Some clots passed per rectum. Last two days patient very drowsy. Still vomits once or twice daily. Is much wasted.

December 3. Patient still very drowsy, sleeping the greater part of the day as well as at night. Appetite bad. Frequent vomiting. Tongue red in patches; lips cracked. Since November 28th taking half a pint of beef tea daily, as well as milk diet. Last night vomited a clot of blood. Pulse small and weak.

7th. Vomiting continues. Anæmia marked. The largest of the retinal hemorrhages is nearly absorbed. Outline of discs clearer. Sight better; can read large type.

14th. Patient seems improving. Pulse 90; stronger than before. Tongue clean.

19th. Can read ordinary print easily. No nausea or vomiting for three days. Appetite good. Sleeps well.

27th. Has only vomited twice since last note. Hot-air bath and dry-cupping discontinued. Gets up for an hour every evening. Taking since December 13th ferri-amm. cit. gr. v, t. d. To have now reduced iron gr. iij three times daily.

28th. Breathing hurried and shallow; pulse 120. Loud systolic murmur at heart's apex.

30th. Dulness and râles at extreme base of each lung. Pericardial friction sound. Morning vomiting.

January 1, 1890. Friction sound still heard.

6th. Inflamed swelling over sacrum. Morning vomiting continues.

7th. Patient's weight this morning is eighty-eight pounds. She says that a year ago she weighed one hundred and twenty-nine pounds.

15th. There has been daily vomiting. Appetite not good; nausea after food. Anæmia very marked. Sight better; can read small print for a short time, but sight soon becomes misty. Heart distinctly hypertrophied; no murmur. Arteries tortuous and thickened.

29th. Vomiting rather less since last note. Weight now ninety pounds.

February 3. Swelling of optic discs has increased again, and there are some recent retinal hemorrhages.

10th. Weight now eighty-five and a half pounds. Is sick every morning; appetite bad.

March 5. Retinal changes more marked; fresh hemorrhages; peripheral atrophic patches. Patient cannot sew or read, or distinguish faces clearly at the distance of a few yards. Condition otherwise much the same. During the last week a good deal of sharp and severe headache. Slight puffiness of eyelids. Vomiting on most days. Is less anæmic. Weight eighty-four pounds.

April 8. Weight seventy-eight and a half pounds. Vomiting continues. Very little nourishment taken.

15th. Transferred to the care of Dr. Ralfe. She remained under his care until July 18th, when she was sent to a convalescent home at Brighton. She was again admitted under Dr. Ralfe's care on September 4th. She suffered much from dyspnœa, sleeplessness and vomiting, and died on September 29th.

Autopsy showed effusion into both pleuræ; pericarditis; hypertrophy of left ventricle; fatty heart; kidneys extremely granular, with lines of calcareous deposit in cortex; weight three ounces each. Liver normal.

Urine. Quantity: From the time of the patient's admission until December 23d (*i. e.*, nearly two months) the urine was collected at intervals of two, three, or four hours, but never less than four hours. If the patient did not herself pass water at these intervals, a catheter was passed. Some urine was unavoidably lost with the motions, and, as the patient had a good deal of diarrhœa, these were frequent. In women there is no practicable means of avoiding this source of error. But in the table the number of motions is shown; and it will be seen that the difference in the number of the stools before and after the augmentation of the amount of urine exhibited in the table is not sufficient to account for the difference in the amount of the urine collected. Although the diarrhœa prevents the observations from presenting an entirely accurate account of the renal function, yet it is not enough to explain the difference from the phenomena of health. There is error, but I do not think it material in amount.

During the first week, the amount of urine was so far below the normal standard that the diminution almost amounted to suppression. The average of the first eight days was two and a quarter ounces per diem. During the next five days the quantity increased, the average for these days being eleven and seven-eighths ounces per diem. During the first eight days the average number of motions per diem was seven and a half, and in the succeeding five days seven; so that the difference in the amount lost at stool is no explanation of the deficient quantity of urine at first. By the end of the period just mentioned the urinary secretion may be considered to have been restored to its normal quantity. In the second fortnight the daily average was thirty-six ounces;

third, thirty-one ounces; fourth, forty-seven ounces; fifth, fifty-nine ounces; sixth, fifty-four ounces; seventh, fifty ounces; eighth, thirty-eight ounces; ninth, forty-eight ounces. After this date it was not collected with so much care. The number of motions was not, after the first three weeks, recorded so accurately; but it will have been seen from the notes that the patient frequently suffered from diarrhœa, and yet the average amount of urine collected was rather above than below the average of health.

It may be suggested that the deficient quantity of urine was possibly due to deficiency in the amount of fluid ingested. To anticipate this, I have stated in the table the amount of fluid taken each day. It will be seen that this does not explain the scantiness of the urine.

Specific gravity: During the period in which the urine was so scanty the quantities collected were not large enough to allow the specific gravity to be taken with the ordinary urinometer. A specimen of October 30th, mixed with one of October 31st, gave a specific gravity of 1006. The specimens of November 3d mixed together gave a specific gravity of 1011. From November 8th onward, the specific gravity varied between 1010 and 1014. Therefore not only was the urine deficient in quantity, but the little urine that was passed was deficient in solid contents as compared with that of health.

Albumin: The quantity of albumin was measured by the eye when the urine had been allowed to stand after precipitation of the albumin. Throughout the whole of the patient's stay in the hospital the urine was albuminous. The quantity varied from a mere trace to half the bulk of the urine. Toward the end of the first week (the week of scanty urine) the amount of albumin was rather greater than at the beginning. But taking the average of various specimens, there was no great difference between the quantity of albumin at the time when the amount of urine was greatly deficient, and that when the secretion had been reestablished. I am not able to point out any circumstances with which I can connect the minor variations in the quantity of albumin.

The extent to which the albuminous precipitate was composed of *serum-albumin* and of *paraglobulin* respectively, was estimated by separating the paraglobulin with sulphate of magnesia and filtering. There were great variations in the relative amounts in different samples on the same day, from causes which I cannot identify. But comparing broadly the relative quantities during the period of great diminution in the quantity of urine, with those after the reëstablishment of the secretion, there is a great difference. During the first week (that of scanty urine) the quantity of paraglobulin was never less than, and usually several times as much as, that of serum-albumin; and on three occasions the albumin was almost all paraglobulin. After the first week the quantities of the two kinds were sometimes equal, sometimes there was more serum-albumin than paraglobulin, and sometimes there was no paraglobulin. Sometimes the paraglobulin was in excess; but there was never such an excess of paraglobulin as was repeatedly observed in the first week.

Urea: Not only was there, during the period of suppression, the deficiency in the elimination of urea which would have been expected from the scantiness of the urine, but the percentage of urea in the urine was much below the average of health, and below even what would have been expected from the specific gravity of the urine. It was estimated by the hypobromite process.

Day of month.	Day of puerperium.	Urine in ounces.	Urea in grains.	Percentage of urea.	Ounces of fluid taken.	Bowel movements.
Oct. 30	1st	2	5	0.7	110	2
" 31	2d	3	7	0.5	40	5
Nov. 1	3d	2	7	0.6	41	10
" 2	4th	3	8	0.7	36	9
" 3	5th	5½	16	0.7	34	9
" 4	6th	6	18	0.75	25	9
" 5	7th	4	14	0.8	34	5
" 6	8th	2	7	0.85	23	6
" 7	9th	12	50	0.9	35	7
" 8	10th	9	42	1.	37	7
" 9	11th	15	66	1.05	42	6
" 10	12th	14	70	1.05	43	9
" 11	13th	8	36	1.	43	9
" 12	14th	19	90	1.1	42	4
" 13	15th	25	114	1.05	43	6
" 14	16th	29	138	1.05	45	8
" 15	17th	42	212	1.1	58	6
" 16	18th	40	220	1.25	44	3
" 17	19th	39	239	1.4	46	3

On admission the percentage was only 0.7. The next day it fell to 0.5. From this date onward there was a gradual but slow rise till 1 per cent. was reached, on the tenth day. Then the percentage continued from 1 to 1.2 per cent. till the eighteenth day. On the eighteenth and nineteenth days there was a more rapid rise, reaching 1.4 per cent. on the latter day. After this, for the next month it was, on the average, about 1.5. From the combination of a diminished percentage of urea with diminished quantity of urine, the absolute amount of urea eliminated by the kidneys was for a fortnight surprisingly small. For the first ten days it averaged 17.4 grains per diem. The next five days show a slight increase, the average being 53 grains per diem. Then it rapidly rose until an average of 200 to 300 grains per diem was reached. The quantities subsequently were as follows:

Second	fortnight,	average	231	grains	per diem.
Third	"	"	187	"	"
Fourth	"	"	198	"	"
Fifth	"	"	215	"	"
Sixth	"	"	265	"	"
Seventh	"	"	163	"	"
Eighth	"	"	146	"	"
Ninth	"	"	155	"	"

It must be admitted that error from the amount of urine lost at stool, unavoidable in women, makes these figures incorrect in the direction of being too low. In relating the quantity of urine passed I have discussed this source of error, and given the reason for thinking that not much urine escaped collection, and that therefore the figures here given are not *much* below the truth.

Deposit: Owing to the very small quantity of the urine, and to this being used for the estimation of urea, the urine was not often examined microscopically. But on the few occasions on which this was done no casts were found.

Briefly: We have here a case in which for eight days the patient passed only about three ounces of urine, and eliminated about ten grains of urea per diem; and yet there were no convulsions.

CASE II. *Eleventh pregnancy: symptoms of renal disease for at least eleven months; œdema; cough; vomiting; labor induced at six months of pregnancy; child living; death two weeks after delivery; no autopsy; urine loaded with albumin and containing casts; almost complete suppression of urine for ten days before admission; for a week after admission urine averaging a little more than three ounces per day; gradual but incomplete reëstablishment of the secretion until three weeks after admission, when labor was induced; after delivery rapid increase in quantity of the urine.* (From notes by Mr. A. F. Peskett, resident accoucheur, and Mr. Cornish, clinical clerk.)—I. R., aged forty-two. Admitted into the London Hospital May 23, 1885. Patient was a street hawker, and had always lived much out of doors. Had taken stimulants freely, mostly rum or gin. Had occasionally suffered from rheumatic pains, but otherwise had had good health until the present illness began. Was married at sixteen, and had had ten children, the last six and a half years ago.

Two years and a half ago she ceased menstruating for two months, then hemorrhage began and lasted ten weeks. She attended for six weeks as an out-patient at the Metropolitan Free Hospital, and got better. Three months after this she found her legs swelling. She went to St. Bartholomew's Hospital, was treated as an out-patient for five weeks, and got better. From this time she continued well until eleven months ago. Then she noticed that her legs were swelling, that her urine looked bloody, and that she had to pass it oftener than she had been accustomed to. She often had shooting pains in the lower abdomen and back. She menstruated the week before Christmas, and she believed herself to be pregnant. For ten days before admission she had passed hardly any water, not more than a teaspoonful at a time.

State on admission: Patient was fairly nourished, and not anæmic. Complained of epigastric pain and flatulence. No enlargement of liver or spleen. Heart's apex-beat in normal position; area of cardiac dulness not increased. Systolic murmur at apex, conducted toward axilla. Arteries rather hard. Breathing rather hurried and labored; bronchial râles over the chest; cough and expectoration. Ophthalmoscopic examination shows nothing abnormal; no retinal hemorrhages or retinitis. Patient complains of severe frontal headache. Abdominal wall and legs œdematous. Uterus reaching to umbilicus.

The catheter was passed on admission, and the night and morning afterward, but only a few drops of urine were obtained each time. All the urine passed or drawn off was collected and measured.

Pulv. jalapæ co., ʒj, was given on the morning following admission, and acted well. Patient was also given pot. acet. ʒss, liq. amm. acet. ℥j, spt. æth. nit. ♏xx, three times a day. In the evening of the day after admission she had a vapor bath, and perspired a little after it. Three times during this day the loins were dry-cupped. The next evening (May 25th) the vapor bath was repeated. On May 26th one-twelfth grain of pilocarpine was administered subcutaneously, and the dry-cupping and vapor bath were repeated. A mustard poultice was applied to the loins, and this was repeated on May 27th. On the evening of May 29th patient had a warm bath, and one-twelfth grain of pilocarpine was given subcutaneously, and these measures were repeated every evening until delivery.

Until June 9th the patient's condition appeared to be steadily improving. The cough and shortness of breath were getting better, and the œdema becoming less. There was throughout occasional vomiting. Pulse was throughout about 76 per minute. The temperature never exceeded 99°.

On June 9th and the following days the patient's breath became shorter, her cough and vomiting more troublesome.

Therefore on June 12th it was decided to induce labor. This was done by the introduction of a bougie between the membranes and the uterus. The patient was delivered on June 14th of a six months' fœtus, which lived about two hours.

The patient died on June 29th; no autopsy was allowed.

The urine was tested on May 24th, June 1st, 8th, and 18th. On the three first occasions it was smoky in color, and loaded with albumin. Its specific gravity on June 8th was 1013, on June 18th 1012. On the two first occasions it contained a deposit of epithelial and blood casts; on the two later, phosphatic crystals. There was no sugar. The urea was estimated on June 8th, by the hypobromite process, and was 0.6 per cent. Its reaction was acid or neutral throughout. The quantities collected are shown in the table which follows. Some was unavoidably lost with the motions, therefore the number of motions each day is also given, so that an idea may be formed of the amount lost.

It will be seen that although the very small quantity of urine may be partly accounted for by assuming that some was lost with the motions, yet that there is no such difference between the number of motions per day in the first week and afterward, before delivery and after, as can account for the great difference in the quantity of the urine at these different periods.

May 24	1 ounce.	2 motions.	1st week, average per day, 2.9 ounces.
“ 25	3 ounces.	3 “	
“ 26	1½ “	3 “	
“ 27	1½ “	6 “	
“ 28	6½ “	7 “	
“ 29	3 “	9 “	
“ 30	4 “	6 “	
“ 31	2 “	5 “	2d week, average 5.8 ounces per day.
June 1	4 “	5 “	
“ 2	4 “	2 “	
“ 3	10. “	4 “	
“ 4	6 “	3 “	
“ 5	8 “	3 “	
“ 6	6½ “	3 “	
“ 7	6 “	3 “	5 days before labor, average 12 ounces per day.
“ 8	10 “	3 “	
“ 9	10 “	1 “	
“ 10	17 “	6 “	
“ 11	18 “	5 “	
“ 12	2½ “	4 “	Bougie introduced. Collection this and following day imperfect.
“ 13	6½ “	3 “	
“ 14	28 “	6 “	Delivery.
“ 15	20 “	3 “	Week after delivery, average 25.2 ounces per day.
“ 16	10 “	3 “	
“ 17	33 “	4 “	
“ 18	30 “	3 “	
“ 19	40 “	1 “	
“ 20	20 “	5 “	
“ 21	28 “	4 “	
“ 22	30 “	3 “	2d week, average 29.3 ounces per day.
“ 23	30 “	2 “	
“ 24	24 “	4 “	
“ 25	30 “	4 “	
“ 26	35 “	3 “	
“ 27	32 “	2 “	
“ 28	24 “	2 “	

Both in this and in the former case, the diminution in the quantity of urine was far below what has been observed in some cases of eclampsia.

In this case, on the unfortunately few occasions on which the urine was examined, the specific gravity was found (as in Case I.) less than normal, and the percentage of urea even less than would have been expected from the specific gravity of the urine.

Seeing how powerful a diuretic urea is, may not the explanation of the suppression of urine in these and similar cases possibly be a deficient formation of urea? This would account for the small quantity of urine, the deficiency of urea in it, and the absence of so-called uræmic symptoms.

ASEPTIC AND ANTISEPTIC DETAILS IN OPERATIVE SURGERY.

By Arpad G. Gerster, M.D.,
of New York.

Though it must be conceded that the process of evolution of the principle which underlies safe operating is a closed chapter in surgery, yet it cannot be denied that means have lately undergone change, and are still undergoing improvement. The main feature of this improvement is the simplification of our procedures. And simplification means an easier comprehension, a more ready acceptance by the general practitioner, and a beneficial spread of the practice of aseptic and antiseptic measures.

One of the most interesting features of the birth and infancy of the Listerian idea was the circumstance that this vast practical revolution in surgical management was based on purely scientific facts, seemingly of mere theoretical interest. I refer to the use made by Lister of Pasteur's researches. To one familiar with the character of these researches, it will be very natural that Lister's first steps in practically establishing the value of Pasteur's results were dominated by the idea of the necessity of chemical sterilization, or, as it was then called, disinfection. How strong and persistent the hold of this thought was upon the minds of men is best illustrated in the remarks made by Lister himself in a lecture or paper delivered not very many years ago. In those days Volkmann taught that in preparing the field for an operation, shaving and scrubbing of the skin ought to precede the application of the carbolic solution. Lister deprecated these measures as over-zealous and unnecessary, and if the printed report can be trusted, the tinge of a sneer was not mistakable in his critical observations. He contended that the great efficiency of carbolic lotion and spray made these plainer methods of disinfection superfluous. Of course, I must add that since then Lister has changed his position.

As a matter of fact there is no doubt now that the powerful action of the razor, of soap, and a stiff brush, goes far beyond anything that can be accomplished in the way of disinfection, even by the strongest permissible antiseptic. We know that, beside the filth adhering to them, epidermis and hair contain not only hosts of harmless and noxious germs, but that epidermis, hair, and clinging filth are all by necessity or accident more or less coated and permeated by various oleaginous substances which form an effective barrier to the penetration of all watery solutions. Hence, to insure the penetration and imbibition of a chemical sterilizer contained in a watery solution it is first necessary to remove this coating of grease. And what agent is better capable of doing this effectually than emollient potash soap, applied with plenty of hot water and the thorough action of a stiff brush made of the bristles of the hog? Grease, filth, and effete epidermis, harmless and pathological germs, are swept away all alike, rapidly and thoroughly, and with admirable impartiality. When the germicidal lotion is finally applied to the cleansed skin, there is very little to kill in the shape of noxious organisms. Lack of time forbids my entering into the scientific demonstration of the facts just related, but I refer those interested in the proofs of the inhibiting effect of oleaginous substances upon the action of aqueous disinfectants to the conclusive article of Schimmelbusch.[1] Far be it from me to depreciate the value of the experiment which demonstrated that a noxious germ finely distributed in a generous quantity of water, to which was added a powerful germicide in a certain minute proportion, would promptly succumb to the deadly influence of this chemical. I only desire to point out the fact that these noxious organisms are not met with in the shape of thin, watery emulsions by the surgeon, but are found imbedded in dense masses of what Lister appropriately called "lumps of dirt," in conglomerations of grease and epidermis, in powerful plugs of sticky slime, pus, and blood-clot. Therefore let us *first* emphasize the paramount antiseptic value of the homely methods employed for cleansing dirty surfaces comprised in the term of *mechanical purification;* and *secondly* point out how infinitely more they accomplish than any form of chemical disinfection by watery germicidal solutions alone. Both should be combined.

Next in importance to the cleansing of the field of operation stands the question of the sterilization of the hands employed at an operation. Both Kuemmel[2] and Fürbringer[3] have brought abundant experimental proof of what enormous quantities of truly pathogenic germs are habitually lodged under the finger-nails of even the most cleanly persons, and especially of physicians. It matters not how often their hands were washed with soap and brush, the scrapings of the finger-nails always contained an abundance of noxious germs. We know that to facilitate digital examination, the surgeon's finger is lubricated with oil or vaseline. Not inconsiderable quantities of oleaginous matter intermixed with pathogenic bacteria persistently cling to the deepest recesses of the subungual space, and this fatty deposit prevents the effective penetration of germicidal lotions. Fürbringer's investigations have shown that the following process will invariably render the surgeon's hands germ-free: The nails should be kept trimmed short; the hands are to be scrubbed with brush and soap in hot water for one minute, especial attention being paid to the subungual spaces, which then are to be scraped carefully with a nail-cleaner, the hands to be immersed for another minute, first in strong alcohol, then in a 1 : 1000 solution of corrosive sublimate. Even hands that were in prolonged contact with intensely septic matter can be instantly rendered reliably aseptic by this process. This is comforting for the surgeon to know, who during the progress of an operation may be compelled to insert his finger into the rectum or oral cavity for the sake of necessary verification.

When my thoughts revert to the old days of spray and unlimited carbolic acid, the first thing remembered is the habitually shocking condition of our hands. Martyrdom means testimony, and the martyred state of our hands bore shining testimony of the earnestness of our faith. We all believed in the necessity of unlimited chemical sterilization, especially as to our instruments. Fortunately, all this has been changed for something better, and this we owe to Davidsohn,[1] who taught us to sterilize instruments by boiling.

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[1] Archiv für klinische Chirurgie, 1891, p. 129.

[2] Centralblatt für Chirurgie, 1885, Beilage zu No. 24, p. 26.

[3] Idem, 1888, p. 83.

But let us first examine whether the usual steps of the mechanical cleansing to which surgical instruments are subjected are adequate or not. That they are very important is very evident, inasmuch as by them is removed the bulk of blood, pus, shreds of animal tissue, and ointments clinging to their interstices and rough surfaces after an operation. Yet even the most thoroughgoing scrubbing in hot water with soap and a stiff brush will not render instruments aseptic. Schimmelbusch[2] has subjected instruments thus cleansed to bacteriological examination. He found that especially to artery forceps a considerable quantity of noxious germs were constantly adherent, and that only the simplest instruments were irreproachable.

Another factor has to be considered. In the large practice of our hospitals, where from three to five operations are performed at one session, the minute cleansing of a large instrumentarium after each operation is tedious, involving considerable time. We either had to submit to this, or had to provide a disproportionately large and costly set of duplicates and triplicates. As a matter of fact, the latter thing was rarely resorted to, and the cleansing of the bloody instruments being hurriedly and often inadequately done, main reliance was placed upon the disinfecting power of our carbolic acid bath. And as consideration for the assistants' hands had gradually caused the abandonment of the stronger for weaker solutions, frequent failures in securing primary union were the result of these evasive attempts.

As mentioned, Davidsohn demonstrated that boiling for five minutes in a covered vessel charged with water was invariably followed by a faultless sterilization of instruments thus treated. But the great drawback of this plan was that all steel objects thus treated, unless they were perfectly protected by nickel-plating, became rusty and were sooner or later ruined. This objection does not apply to its full extent to sterilization by superheated air; but the necessity for costly apparatus and the tardiness of the process[3] make this plan evidently impracticable. Sterilization by steam presents the drawback of rusting in a still greater degree.

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[1] Berliner klinische Wochenschrift, 1888, No. 35.

[2] Loc. cit, p. 147.

[3] Poupinel: "La sterilisation par la chaleur," Revue de chirurgie, 1888, p. 669.

If we then had some reliable means of safely preventing the inroads of rust upon our instruments during sterilization by boiling, we would possess a rapid, simple, and thoroughly practical way of accomplishing our purpose. Common washing-soda, as found in every household, if added in the proportion of one per cent. to water, is endowed with the valuable property of preventing the formation of rust on steel during boiling. And we owe this expedient to the ingenuity of Schimmelbusch.

Let me now practically illustrate in another direction the vast importance of this simple, rapid, and reliable manner of cleansing instruments. It must appeal with peculiar strength to the sensibilities of the general practitioner and country surgeon. Look at the ordinary surgical pocket-case, containing the chief and often only available instrumentarium in a grave case of emergency. Its leather and lining are well worn and more or less soiled, both from long use and the necessity of carrying it about with us in hot and cold weather, rain and shine. Bathed in the vapors of perspiration, freely accessible to dust and dirt, it soon becomes the very negation of what is tidy. Imagine that a fresh case of compound injury to bone or joint, vessel or tendon, has to be dealt with, and that at once. Under these circumstances the instruments drawn from the pocket-case were always employed by me with much reluctance and no little trepidation. Only when the case brooked absolutely no delay and could not be tided over by temporary expedients permitting postponement of the operation to a safer occasion, did I operate. The cleansing that could be bestowed on such instruments on such occasions must needs be inadequate, and one had no choice but to trust to luck.

How different matters are, when we know that to put our instruments in a perfectly aseptic condition we need only a covered pot of boiling water charged with washing-soda, one tablespoonful to the quart. After five minutes of ebullition the contents of the pot, instruments, water and all, are emptied into a clean pan, and the operation may proceed.

In hospitals a sufficient supply of cold sterilized soda solution can be kept on hand, to be poured over the hot instruments as soon as they are placed in the instrument tray. Lately we have used at Mount Sinai Hospital simple boiled water for this purpose, with perfect satisfaction.

In recapitulation, we will say that instruments should be first cleansed with soap, water, and brush, then boiled for five minutes in a covered vessel containing a watery solution of washing-soda 1 : 100 (one heaped tablespoonful to the quart).

We have seen, from the preceding remarks, how important a rôle is played in modern surgery by the humble scrubbing-brush. And yet there is no other implement so generally neglected as this, and none that receives less care in practice. In hospital and the private office we see the brush used indiscriminately on the hands of the surgeon, the skin of the patient, in close contact with vaseline, feces, urine, sputa, blood, pus, ichor, and what not. After use it is deposited on the washstand without any special care as to the removal of filth clinging to thousands of bristles and their interstices. It is no wonder that brushes thus treated become very hotbeds of infection.

Various expedients were employed to overcome this obvious evil, among which shall be mentioned first the exclusive use of new brushes in the preparation for each major operation, especially laparotomies; then the disinfection of brushes by continuous immersion in strong sublimate of mercury solution, and finally, the rejection of all brushes and employment of bundles of excelsior instead, which are thrown away after each single use (Neuber).

On account of its great effectiveness the banishment of the brush could be viewed by the surgeon only with regret. Hence let us examine whether a simple and practical way has not been devised to keep this implement clean.

I have again to refer to Schimmelbusch,[1] who has shown beyond any reasonable doubt, that a single and brief immersion in a strong germicidal solution is inadequate to destroy the noxious forms of bacteria contained in surgical nail-brushes. He found that brushes used in the wards and private rooms of the Berlin clinic, which were simply kept in the stereotyped dish alongside of the wash-basin, literally swarmed with pyogenic organisms. Further, he established that to satisfactorily disinfect a brush containing pathogenic germs, an immersion in strong mercuric solution of at least ten minutes was indispensable. If we consider how often brushes fresh from use on infectious cases and still filled with soapsuds are thrown back into the vessel set aside for their immersion, there to give up their contents of soap, which render the sublimate solution inert, we must conclude that under such circumstances even fifteen or twenty minutes will not accomplish a perfect sterilization. Hence we see with pleasure the demonstration of the fact by Schimmelbusch, that boiling of the most unclean brush for five minutes in a 1 : 100 soda solution will always render it absolutely aseptic. Ordinarily, then, surgical brushes should be always kept immersed in a 1 : 1000 sublimate solution, and should be always boiled before laparotomies, or whenever intensive infection has occurred. Finally, brushes carried about in the open satchel of the surgeon, or those found on the washstands of patients, should also be boiled before use.

Whenever I have watched the process of impregnation of our absorbent dressings, as it is carried on at our large hospitals, I could not avoid the feeling of uncertainty regarding the desired result. The repeated handling of large quantities of material by a certain number of persons required in folding, immersing, wringing, unfolding, drying, refolding, cutting, and final storing, cannot but impress the observer with the suspicion of contamination. Add to this the mistakes made in mixing the solutions used for impregnation, and the resulting over- or under-charging of the dressings with chemicals prone to evaporation or chemical change, and it will be seen that impregnation itself is apt to be very uncertain as to its absolute value. As to the merits of the processes employed by various manufacturers in preparing disinfected dressings, I will only remark, that as their gauge of success is a purely commercial one directed solely to profit, the work being done by persons to whom the essence of a surgically clean procedure is a matter of utter indifference, their trustworthiness must be a factor not amenable to direct proof and demonstration.

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[1] Loc. cit., page 161.

But let us see wherein dwells the antiseptic property of our surgical dressings. Can is be the inconstantly represented chemical agent, which even if present in the prescribed quantity, is nearly inert, or is it some other factor? The answer is that we know that the high antiseptic value of our intensely absorbent dressings depends on their quality of favoring rapid evaporation, rather than on any chemical properties they may possess. The curing of meat and fish by exposure to the sun is one of the most ancient preservative processes, and well known to be highly effective. As to the effect of evaporation upon pathogenic microbes, Schlange[1] has shown that the bacillus of green pus, for instance, inoculated upon moist pads of cotton—was aggressively prolific if kept under a glass cover which prevented evaporation. On the other hand, its proliferation was immediately checked if the pads were freely exposed to air and became dry by the loss of moisture. I cannot but fully indorse the statement made by Schimmelbusch, that the effectiveness of highly absorbent and rapidly drying dressings, even if they contained a moderate amount of schizomycetes, is much greater than that of materials which, however faultlessly impregnated, are lacking the properties just mentioned, as, for instance, Lister's resinous gauze.

Looking aside from the objectionable and unreliable features of impregnation itself, let us not forget the disagreeable influence of the chemicals used in this process upon the skin of surgeon and patients. The intensive eczema so frequently produced underneath our sublimate and carbolic dressings is a serious drawback of not small moment.

All these objections vanish if preference is given to one or another mode of sterilization by dry or moist heat. Of these modes only three need to be considered.

First comes the simple process of boiling. For purposes where a reliable dressing has to be procured, *extempore* boiling in a soda or potash solution of about 1½ per cent. for ten minutes is incomparably the simplest and most practical manner of getting an absorbent and aseptic material. In this procedure we recognize at once the familiar ways of the laundry, the eminently aseptic results of which have been demonstrated beyond any reasonable doubt by Behring[1] in the Berlin Hygienic Institute. Thus cotton or linen stuff, to be found in every household, can be rapidly rendered serviceable for surgical purposes by a short boiling in soda or potash lye. Well rung out, it can be immediately used, and will dry rapidly *in situ* under the influence of the body-heat and exposure to the air.

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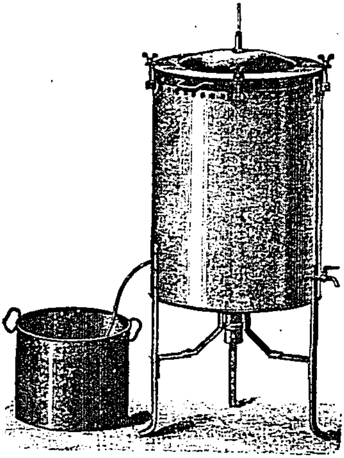
[1] Archiv für klinische Chirurgie, 1887.

Sterilization by hot air has also been shown to be sufficient, and would deserve serious attention but for the necessity of employing costly and complicated apparatus.

FIG. I.



Lautenschläger's apparatus for the sterilization of dressings by steam.

But these objections do not prevail as to a steady current of slightly superheated steam. The apparatus needed for this purpose is simple, cheap, and durable, and as I have ascertained during an extensive tour of investigation, embracing a considerable number of Continental clinics, has been and is there universally employed with unvarying satisfaction. The apparatus I refer to is made by Lautenschläger, in Berlin, from plans by Schimmelbusch, and has several features to commend it. First, its moderate cost, easily afforded by every hospital, and even a busy surgeon. Secondly, the absence of the danger of explosion, the rapidity with which it is set in motion, and the thoroughness with which every fibre of the articles placed within it is permeated by steam, which enters the receptacle containing the dressings from above, displacing all atmospheric air, finally escaping through a tube at the bottom of the apparatus, whence it is conducted into a pail of cold water to effect its precipitation.

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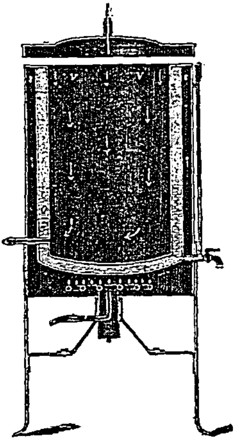
[1] Zeitschrift für Hygiene, 1890.

Another ingenious feature of this apparatus consists in the employment of a number of perforated tin boxes, which can be closed at will, each of these containing everything that is to be used at a given operation. Supposing that three operations are to be done, one after another, three of these boxes are charged each with all the dressings, towels, and surgeons' gowns to be used on that occasion, and are placed within the steam-chamber of the apparatus. The flames are lighted, and counting from the time that the thermometer connected with the apparatus indicates 100° C. the contents are exposed to the action of steam for forty-

FIG. 2.



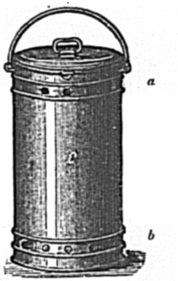
Sectional view of Lautenschläger's steam sterilizer.

five minutes. After this the boxes are taken out, their air-holes are closed, and the dressings in them remain clean and undefiled by any contact until the moment when they are taken out and applied to the wound.

Protected from all undesirable contact by the tin case, aseptic dressings can be thus transported anywhere, to be used wherever occasion requires. I need not add that gauze or cotton is not rendered absorbent by steaming alone, and must possess this property before sterilization. This apparatus was recently acquired for Mount Sinai Hospital, New York, where it can be inspected.

Dressings thus prepared possess all the requisites demanded by modern surgery. They are cheap, aseptic, can be kept so indefinitely, and do not irritate the skin.

FIG. 3.



Schimmelbusch's box within which dressings are placed in steam chest of sterilizer. *a* and *b*, air-holes.

The sponge is a surgical requisite so full of excellent qualities that no substitute has as yet succeeded in displacing it. A very good article, known as the Florida sponge, can be bought here for such a trifling sum that we can easily afford to use a sponge but once. Among the many processes recommended for its disinfection, that by boiling is to be absolutely condemned, as it robs the sponge of its most valuable properties—its softness, elasticity, and power to absorb. One of the most effective processes has been abundantly tested by myself in hospital and private practice for seven years, and these are its simple details: The sponge is to be freed of its calcareous impurities by dry beating and a short immersion in standard dilute muriatic acid. Traces of the acid having been washed away, the sponges are left for two days in water to give the spores contained in them a chance to germinate. The reason for this is the fact that proliferating microbes succumb much more promptly to germicides than their spores. After this process of fermentation the sponges are thoroughly kneaded by hand, each for a minute, in plenty of hot water and potash or soft-soap, which will thoroughly macerate and mollify hard lumps of dirt that may be imbedded in the densest and central parts of the sponge, thus rendering them, as it were, penetrable to the action of germicides. After all traces of soap are removed, the sponges are thrown into a five per cent. solution of carbolic acid, which I prefer to corrosive sublimate for this purpose, as it does not become inert as easily as a metallic compound. An immersion extending over twenty-four hours will render the sponges absolutely sterile and fit for use. Should it for economic reasons be desired to use sponges oftener than once, this same process will be just as effective to purify them.

The large flat sponges so generally used in laparotomy have been abandoned by me for three years as expensive, and not as handy as small, well-sterilized compresses of plain absorbent gauze, which, to prevent unfolding and fraying, are firmly tied with silk at one end. The surgeon is nowhere so cramped for lack of space as at his operations in the bottom of the pelvis. A sponge used for packing away intestines needs constant pressure to prevent its expansion and encroachment upon available space. A pad of gauze held down for a short while will become packed, and will retain its shape and position even if released from digital pressure.

When I approach the vast subject of *operative technique,* indissolubly connected with the principle of asepticism and antisepticism, I confess to a feeling of helplessness. Hours would be required to do justice to the intimate connection and interdependence of these subjects, and I must content myself with giving you a few glimpses only. The enormous increase in the ratio of safety in operating caused by anti-parasitic measures has led to curious results. A clumsy and rough operator who is a thorough antiseptician is often very successful. On the other hand we see very dexterous men suffer disheartening discomfitures on account of disregard of the maxims of cleanliness. This is not said to encourage clumsy operating. On the contrary, I must declare what all of you know already, that the most brilliant triumphs of surgery are won in these days by those who combine technical skill, the cunning of hand and brains, with the conscientious practice of a thoroughgoing cleanliness. The neglect of cleanliness will meet in no field of human activity with a swifter and more certain retribution than here; hence I may say that cleanliness is one of the most important and truly ethical factors in the honorable pursuit of our noble art.

The barbaric elements of the neglect of cleanliness and inattention to hemorrhage, the rough methods of evulsion, the slashing and tearing, often made necessary in former days by the absence of anæsthesia, have almost all been eliminated from surgery. Dissection is made safe by adequate incisions and by the control of hemorrhage, which keeps the field of operation comparatively dry. By the skilful use of retractors the track of the knife is laid bare to the scrutiny of the eye; and blunt methods of severing tissues being avoided wherever possible, clean-cut surfaces are left behind, more prone to heal than bruised and torn ones.

The immediate effect of anti-parasitic principles upon the improvement of operative technique is nowhere more evident than in those procedures where internal sources of infection are encountered and set free during an operation, as, for instance, in the excision of tuberculous, suppurating joints and glands, in the removal of the diseased appendix vermiformis, the evacuation of the intra-peritoneal abscesses, and the excision of suppurating abdominal tumors. To prevent accidental contamination of healthy surfaces, or, if unavoidable, to neutralize its bad effects, can be truly said to be a newly developed art. I may also mention the enormous progress in the safety of surgical interference in operating upon organs that can never be called aseptic: as, for instance, the rectum; the oral cavity—in fact, the entire digestive tract; the bladder, and the uterus. Here operative technique in the old sense, and antisepsis or asepsis, are so intimately blended that they cannot be safely separated, and ought to be taught together by book and example.

To illustrate the meaning of these remarks, I may be permitted to mention a few examples. To insure the success of an extensive excision of the rectum for cancer, we perform preliminary colotomy. Thus we divert feces and contamination from the field of operation, rendering it aseptic as far as possible. Likewise we open the membranous portion of the urethra and pass a drainage-tube into the bladder, in order to prevent the infection of a urethroplasty wound by ammoniacal urine. Not long ago, in performing a needful herniotomy upon a boy-child, I have, to prevent the soiling of the wound by urine, performed external urethrotomy with success. All these operations represent improvement of operative technique in a wider sense.

The field we have here touched is one where a clear line of demarcation between aseptic and antiseptic measures cannot be drawn. In many of the cases belonging to this order, *irrigation* is an important element of success; therefore let us devote a few words to the subject of irrigation.

The wholesale condemnation of irrigation as employed in the past is just as sure a sign of superficiality on the part of the critic as the slighting of the important rôle of antiseptic agents in former periods of the antiseptic method. As long as the preparatory measures to an operation were rather perfunctory; as long as the skin, the surgeon's hands, his sponges, instruments, and dressings were indifferently cleansed, the continuous use of disinfectants during and after the operation was necessary to insure success—that is, to ward off virulent suppuration. Similarly, under those conditions, the use of continuous irrigation during operations was justified by the general improvement of results observed after its employment. As we have learned to lay greater stress upon and practice a more exact form of preparatory asepsis, so the necessity for chemical germicides and irrigation has been restricted. But both of these agents have furnished a valuable and necessary link in the chain of development of the discipline. This view is confirmed by the fact that practical experience tells us how indispensable irrigation still is to the safe performance of many operations done in regions which can be rendered and kept aseptic only with great difficulty or not at all. Here, too, the mechanical effect of the stream of irrigating fluid is infinitely more important, in my opinion, than the chemical influence of the weak solutions generally used. It is rather the rush of the fluid washing away impurities than the salicylic or boric acid dissolved in it that is effectual.

Accordingly, we rarely employ irrigation in wounds that are known to be free from infection, and with few exceptions never take strong solutions, the use of which has produced in the past a considerable number of fatal intoxications. By eschewing chemicals we also have seen hæmostasis become easier, and especially have observed that the troublesome oozing of the fresh wound has been almost entirely done away with. Our dressings grew less bulky and cumbrous; they could be left longer undisturbed, and, what is an important item in the amputation of limbs, could be bandaged on with less pressure, whereby the danger of marginal necrosis of the flaps is materially diminished. In short, the dryer the operation, the dryer was the course of healing. How this matter has affected the question of drainage we shall consider presently.

To sum up we shall say, then, that irrigation of an aseptic wound is unnecessary, even harmful; that it should be only employed in wounds which are *per se* not aseptic, such as those in the vicinity of or within the several orifices of the body—as, for instance, the rectum, oral cavity, and vagina; that irrigation is well employed during operations in and about accidentally infected or suppurating areas. *A notable exception to this rule is the abdominal cavity, wherein irrigation is never to be employed.* This statement seems to condemn a widely spread practice, and some courage is needed to express it unreservedly. But both experience and scientific experiment support this view. It will be objected that a vast array of cases is on record wherein irrigation of the abdominal cavity was practised successfully by eminent surgeons. To this we reply, that where harmless substances, as, for instance, blood, non septic contents of cysts, or abacteric pus from a ruptured pyosalpinx or ovarian abscess, have accidentally soiled the peritoneum, the simple wiping off of the bulk of these substances is sufficient to eliminate danger; that in these cases irrigation is unnecessary, and that recovery takes place rather in spite than in consequence of irrigation. How entirely useless, nay, pernicious, the effects of flushing the peritoneum are in cases of active septic infection, as, for instance, in the presence of fetid fecal abscesses due to intestinal perforation, has been abundantly demonstrated to myself and to other surgeons here and abroad by numerous unsuccessful attempts. And there is nothing more certain than that, on account of its complex character, the peritoneal cavity cannot be completely washed clean; that germicidal solutions cannot be used in a sufficient strength to be effective, and that finally an inert or weak solution will only help to spread the elements of infection to previously unaffected areas. The substance of these assertions was essentially confirmed by experimental research on animals.[1]

I take this opportunity for a short diversion to a subject still discussed by surgeons and deserving some notice. Most operations within the peritoneal cavity afford no very rigid test of the absolute value of the aseptic measures therein employed. The tolerance of the peritoneum is almost incredible, and technical sins committed during abdominal operations against the accepted rules of cleanliness, proper dissection, hæmostasis, go much oftener unpunished than those incurred at an amputation, resection, osteotomy, or the excision of extra-abdominal tumors —in fact, at all major operations performed outside of the belly. But let the limits of peritoneal tolerance once be overstepped and usually the damage becomes irretrievable; the patient generally dies of septic peritonitis, for which there is no adequate corrective. On the other hand, if extra-peritoneal regions manifest less tolerance of slipshod methods, the consequences of surgical shortcomings are here often retrievable by corrective measures of one or another kind. The tolerance of the peritoneum was only too often the mantle of charity under which were hidden from view sins of omission and of commission of laparotomists without surgical training. In laparotomy more than anywhere else the most rigid asepsis is a conscientious duty.

Intimately connected with the change of views respecting preparatory asepticism and irrigation is the shifting of our standpoint regarding the application of *drainage*. Imperfect cleanliness, copious irrigation, and abundant drainage represent the links of a chain forged by necessity. A faultless asepsis has often enabled us to do away both with irrigation and drainage. Wounds of a moderate extent, for instance, made in herniotomy, if really aseptic, their dissection clean, and hæmostasis perfect, will behave correctly under an hermetic collodion dressing, and exactly like a subcutaneous injury. The oozing will be very moderate, scarcely penetrating the thin coat of gauze soaked in collodion, swelling none, and after the lapse of ten days we shall find the catgut stitches absorbed and the wound perfectly healed. This is a common observation of modern surgeons and does not need specific verification. The same principle finds a different application in certain operations about the joints and bones, when so-called "dead" spaces must needs be left behind. As most of these operations are done with the aid of artificial anæmia considerable oozing of blood follows the removal of Esmarch's bandage. This blood fills up the irregular cavities left by the surgeon, and, coagulating, forms there a solid aseptic plug, which is gradually consumed and replaced by connective-tissue elements of new formation. For seven years I have abandoned the use of drainage-tubes in those excisions of joints and sequestrotomies where it was possible to remove all diseased tissues in an unexceptionable manner. According to Schede's plan, I have only provided an avenue of egress for the first onrush of oozing blood by leaving one or another angle of the wound somewhat patulous. A film of protective over this little gap will prevent the absorption of the blood needed for filling up the irregular cavity of the excision wound, and will maintain sufficient moisture to prevent the exsiccation of the coagulum.

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[1] P. Delbet: "Recherches expérimentales sur le Lavage du Péritoine." Annales de Gyn., xxxii. p. 165.

And even in operations where we are not absolutely certain of the aseptic condition of our wound we can often dispense with the use of drainage-tubes, and not incur any serious risk. Bergmann first demonstrated that a wound of doubtful asepticity can yet be made to heal by primary adhesion. He passed his suture points through the edges of the wound, but leaving them untied, and then packed the open wound and all its recesses down to the bottom with iodoform gauze. Over this was placed the usual outer dressing. Through the capillary action of the gauze copious oozing of serum was encouraged, which in about sixty hours lost its sanguinolent character, whereupon the packing being extracted the suture points left *in situ* were closed, and the wound was seen to heal in a manner little differing from primary union. Undoubtedly, much of the success of this plan of packing and secondary suture is to be attributed to the action of iodoform, which has triumphantly withstood various attacks upon its reputation.

Still another modification of this form of drainage is now extensively employed in abdominal surgery, where, on account of much unavoidable denudation or accidental infection, copious oozing is to be expected. Mikulicz was the first one to employ the iodoform-gauze packing successfully in the abdominal cavity, and his plan has met with widespread and deserved acceptance. First, it does away with the use of the drainage-tube, and secondly, its contact with the peritoneum causes just enough adhesive irritation to insure after its removal rapid agglutination of the raw surfaces. Immediate closure of the wound can be practised after extraction of the packing. But *drainage by tubes* still remains indispensable where acute progressive suppuration has to be dealt with, as an ample way of egress must be provided for sticky and coherent masses of pus, blood-clot and sloughing tissue.

By touching this subject we have entered the realm of *antisepsis* proper. Let us now consider the comparative value of the principal measures employed for combating active, destructive suppuration, the form of infection which the surgeon has to encounter most frequently. I unhesitatingly declare, and lengthening experience tends only to confirm my conviction, that here as elsewhere, purely mechanical measures employed with a view to the removal of excessive tension and the thorough evacuation of noxious matter, such as adequate incision, properly placed drainage, the extraction of sloughs and sequestra, with frequent energetic irrigation, play a much more important part in checking mischief than chemical disinfection. Even in the treatment of destructive ulcers the constant bath and actual cautery are found to be more effective than chemical applications, though the great usefulness of the latter cannot be denied in milder processes of a superficial character.

We have seen that dry absorbent dressings, favoring rapid evaporation, are most useful in the treatment of extensive aseptic wounds, and that smaller aseptic wounds can be advantageously sealed with an hermetically occlusive collodion pad. An entirely different principle obtains in the dressing of septic or suppurating lesions, surgical or accidental.

While capillary attraction, exerted by a dry absorbent dressing, is perfectly adequate to drain an aseptic wound of its serous discharges and while the rapid drying and crusting of these dressings is just the thing we want to seal a sweet wound against the possibility of subsequent infection from without, these very qualities of the dry absorbent and occlusive dressing make it unfit for use in cases where the secretions are purulent. To begin with, pus contains so many corpuscular elements in the shape of leucocytes and shreds of decayed tissue, all suspended in a more or less viscid medium, that capillary absorption alone cannot effect much more than the removal of a portion of its serous components. The remainder, containing the more solid part of the discharges, becomes inspissated and forms a crust. Thus, artificially, retention and an aggravation of the existing mischief is brought about. A moist dressing, protected against evaporation either by remoistening or an outer covering impermeable to moisture, does not possess these disadvantages. Inspissation being prevented, the escaping pus retains at least its original density, and is evenly absorbed and distributed through the interstices of the entire dressing. Crusting and retention will be prevented, especially if the dressings are frequently renewed. An additional and very valuable quality of the moist dressing is the soothing effect it exerts upon the inflamed parts. It soon acquires the temperature of the covered region, and the combination of warmth and moisture presents the most valuable features of the time-honored poultice without its drawbacks.

Is the impregnation by germicides of moist dressings used in cases of suppuration effective and necessary, or not? My answer is unhesitatingly negative. While the microbes contained in dense masses of pus will remain unscathed by the minute quantities of a chemical contained in our dressings, these will be very often sufficient to irritate the skin into florid eczema. Adequate incisions, efficient drainage, frequent change of dressings supplemented by irrigation, contain the essence of the successful treatment of suppuration.

In summing up we will say, finally, that though chemical sterilization is still important, and even indispensable in some fields of modern surgery, main stress belongs to those mechanical measures of purification which comprise the essential part of aseptic preparation.

Having passed in review the present status of anti-parasitic surgery we see that, although incisive changes have befallen the means employed, the principle upon which the discipline was grounded remains unshaken. The living spark of truth has survived the pedantry and over-zeal of the advocates, as well as the sneers and contempt of the opponents of the new departure. Its blessings have soothed and removed untold suffering and misery—have saved, I might say, millions of lives. For all this, humanity is indebted to one man, whose intellect pierced the deadly mists that overhung the practice of surgery. That to the activity of the surgeon, though it still remains surrounded by grave responsibilities, was added a vastly increased element of pleasure, the *gaudium certaminis* against disease and death—for this gift to his fellow-surgeons, we are indebted to Sir Joseph Lister.